

# WAVES\_2006 (Water Vapor Validation – Satellite/Sondes)

*An Aura/Aqua satellite validation field campaign hosted at the  
Howard University Research Campus in Beltsville, MD*

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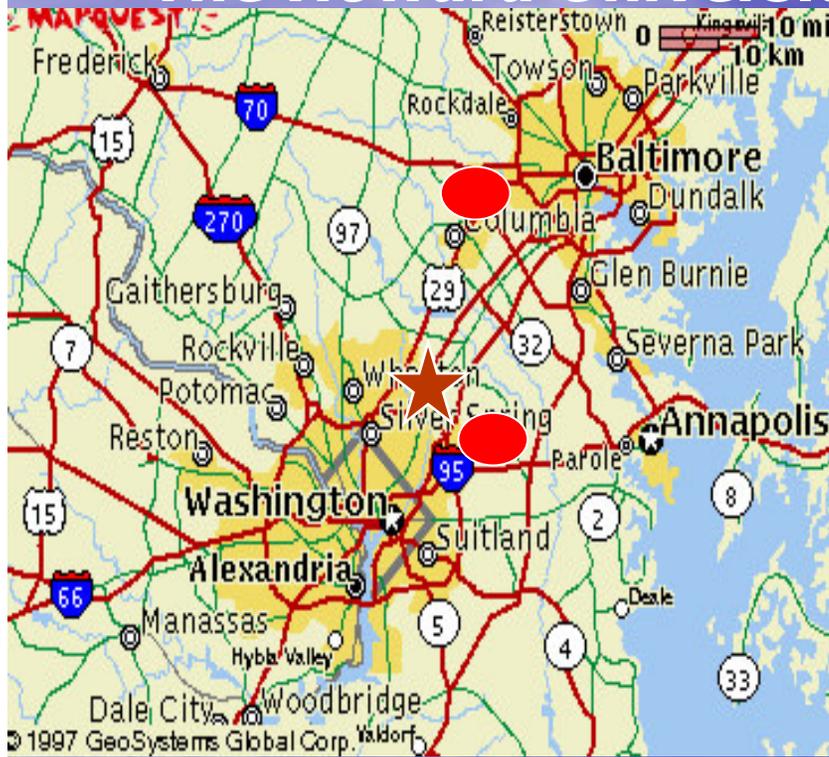
10 Trinity University, Washington, DC 20017

11 Instituto de Pesquisas Energeticas e Nucleares (IPEN), Sao Paulo, Brazil

12 University Mayor de San Andrés, La Paz, Bolivia

13 NOAA/NESDIS Camp Springs, MD

# The Howard University Beltsville Research Campus



- **A semi-urban field site**
  - Mid-Atlantic, urban experiences a wide range of meteorological conditions
  - A major pollution corridor.
  - High population pressure
  - Provides environment very different than ARM sites
- **Comprehensive set of Observation Systems**
  - IONS site for the past three years
- **Opportunities for inter-agency and university collaboration.**
  - Integrate Science and Education



# ***Beltsville Campus Instrumentation***

## **Aerosol-Cloud-Radiation**



## **Atmosphere-Surface**



## **Air Quality**



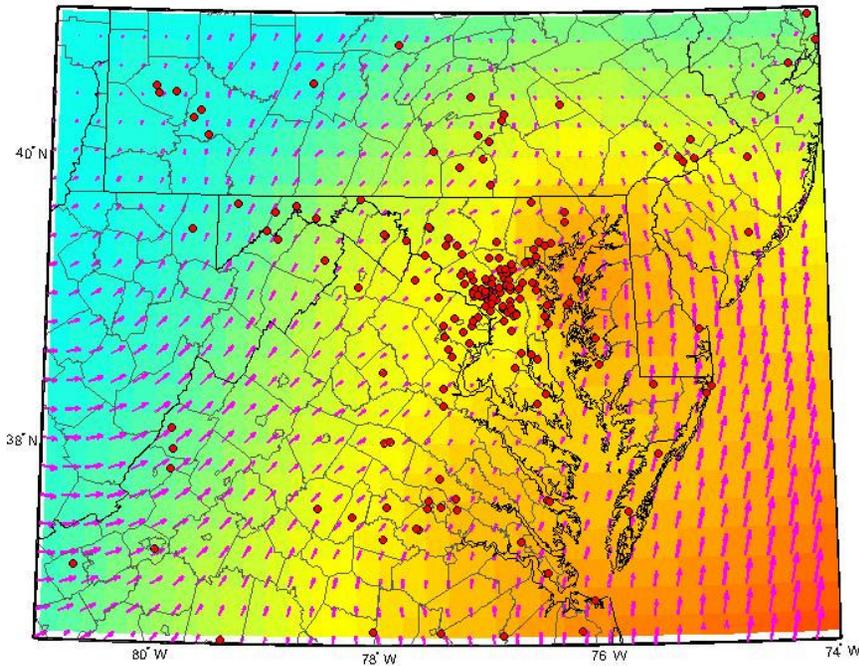
## **Integrating Research and Student Training**



# Student Theses Using WAVES Data

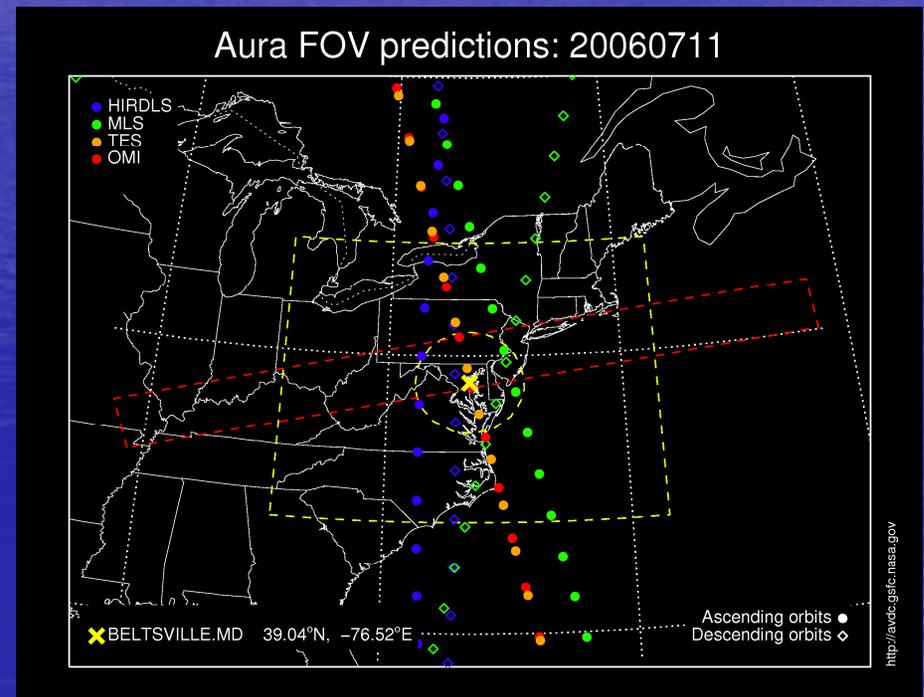
- Howard University
  - lidar cirrus cloud measurements (Connel)
  - Mesoscale convective studies using WRF (Walford)
  - Aerosol indirect effect (Nzeffe)
  - Model vs observed fluxes (Robjohn)
- UMBC
  - Aerosol hygroscopic growth (Rogers)
- Penn State
  - TDB but much data acquired by NATIVE during WAVES

# WeatherBug Mesonet Centered on Beltsville



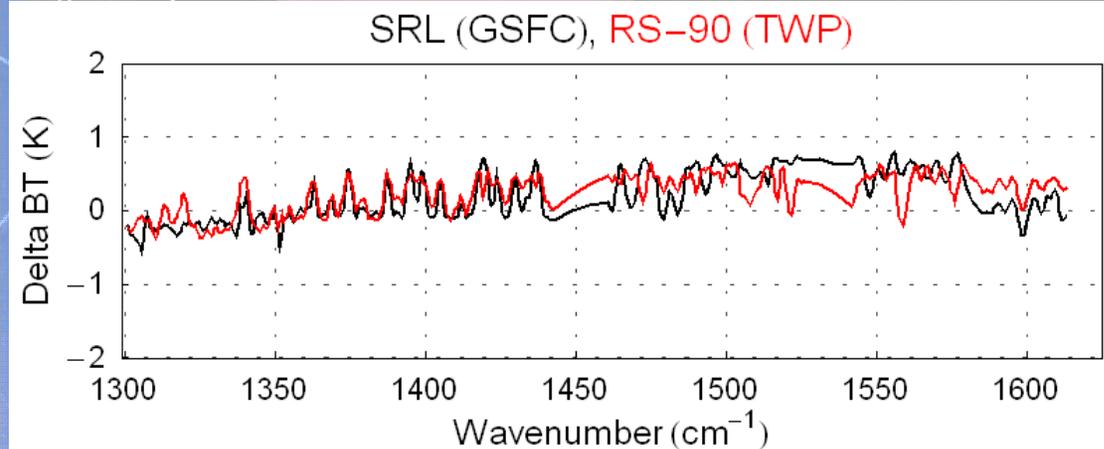
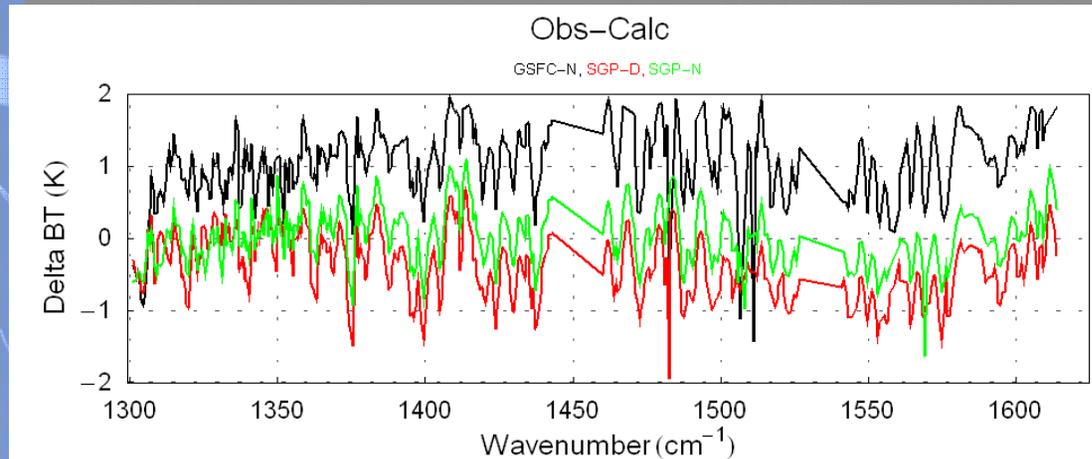
Pressure, Temperature, RH, winds,  
rainfall at distributed sites (5 min).

## Favorable location for Aura/Aqua overpasses



# AIRS Water Vapor Experiment-Ground (AWEX-G)

- **Held at DOE/SGP in Oct-Nov, 2003**
  - Various water vapor measurement technologies
    - Sondes: Vaisala, Intermet, Sippican
    - Cryogenic Instruments: CFH, SnowWhite
    - Lidars: CARL, SRL
    - Total column: MWR, GPS
- **Results**
  - Validation of empirical correction for Vaisala RS80 and RS90/92
  - Validation of physical corrections to Raman lidar



Miloshevich, L. M., et al. *J. Geophys. Res.*, 111, (2006).  
Whiteman, D. N., et al., *J. Geophys. Res.*, 111, (2006).

# WAVES\_2006 (June 27 – August 12, 2006)

- Goals

- Provide water vapor and ozone validation data for Aura/Aqua
- Assess current calibration of RS92
- Assess UT water vapor measurements of Raman lidar systems
- Study regional water vapor/aerosol variability
  - Satellite retrieval sensitivity
  - Mesoscale studies

- Operations

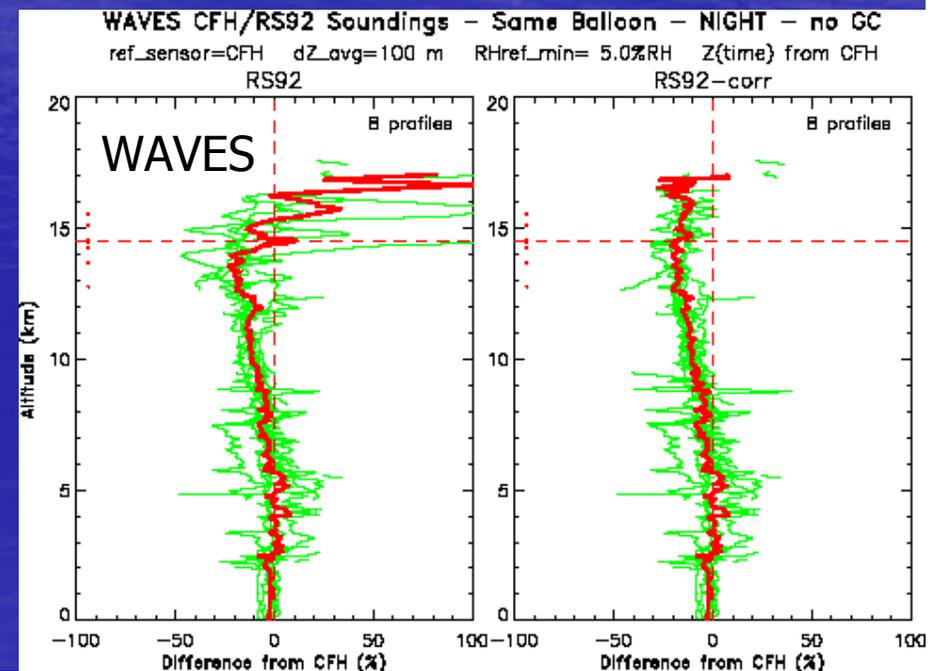
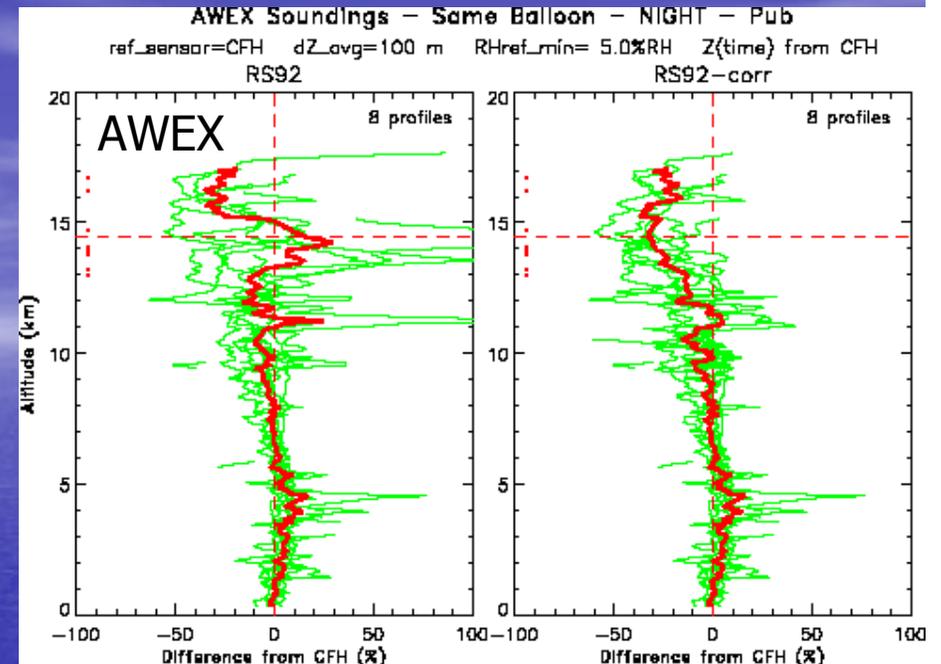
- ~35 A-train overpasses covered
  - 143 sondes including 15 CFHs, 35 ozonesondes and 7 technologies of PTU sensors (coordinated with overpasses)
  - Coordinated operations with 7 lidar systems (5 Raman and 2 backscatter)
    - Water vapor, aerosols, temperature

- Analysis status

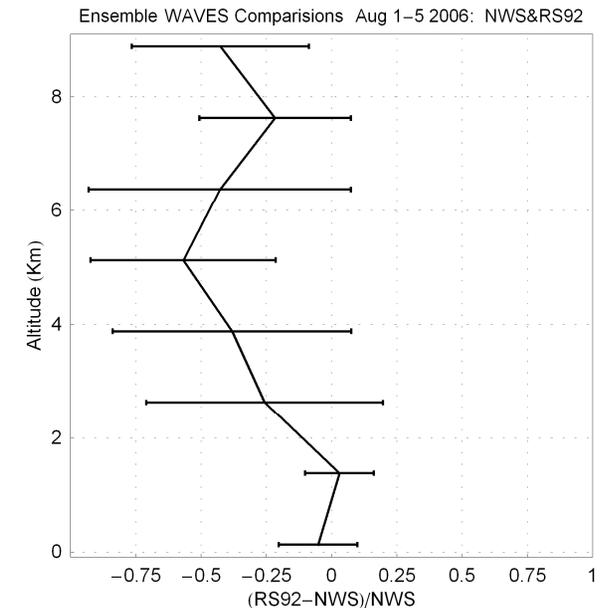
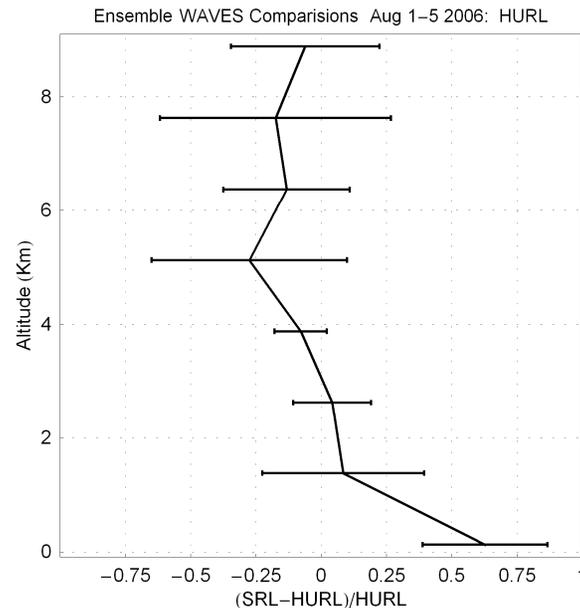
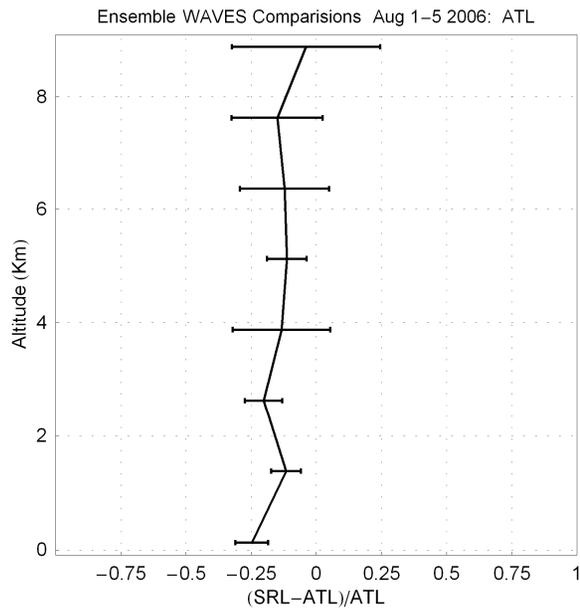
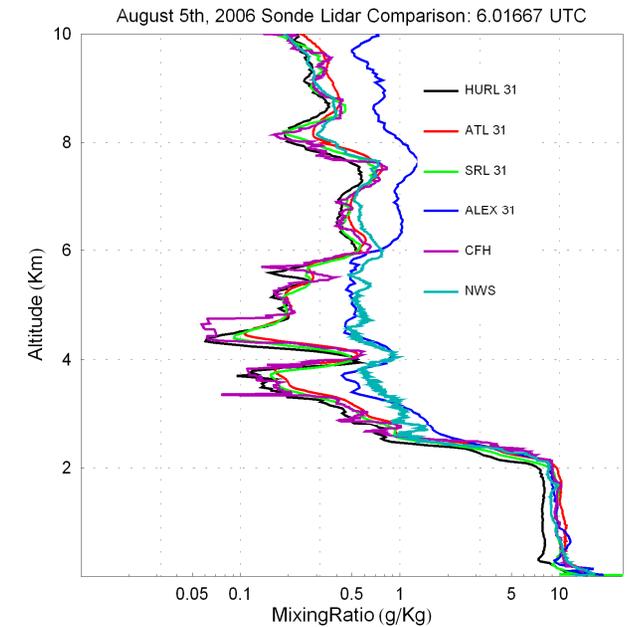
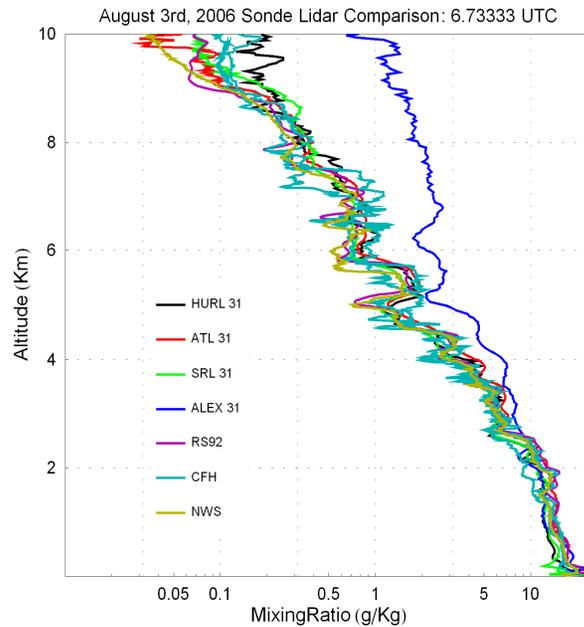
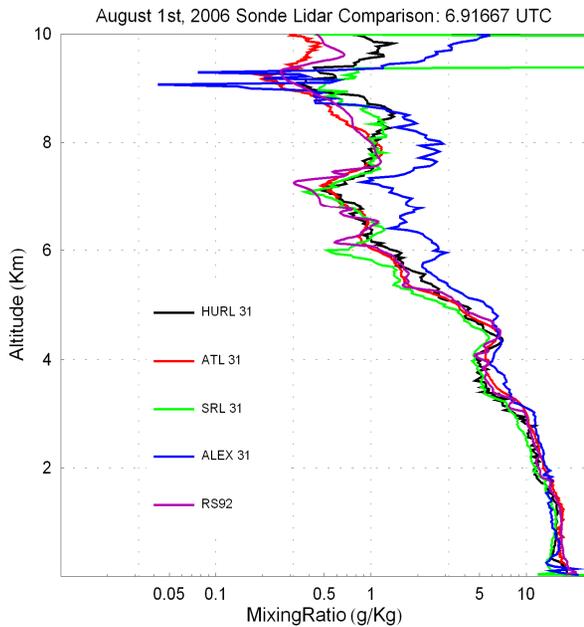
- Data QC in progress
  - RS92/CFH comparisons in progress
    - Empirical correction to RS92
  - Sonde/lidar/satellite intercomparisons in progress

# Vaisala RS-92 Corrections vs CFH

- Vaisala RS92 (un-announced!) calibration changes
  - June, 2001
  - June, 2004
- Periodic checks on Vaisala calibration desirable
  - Comparisons with respect to Cryogenic Frostpoint Hygrometer (CFH)
- Preliminary WAVES results indicate that CFH/RS-92 nighttime performance is closer to CFH
  - Still 20% dry bias observed in UT at night
  - Increases to ~40% dry bias in UT in daytime

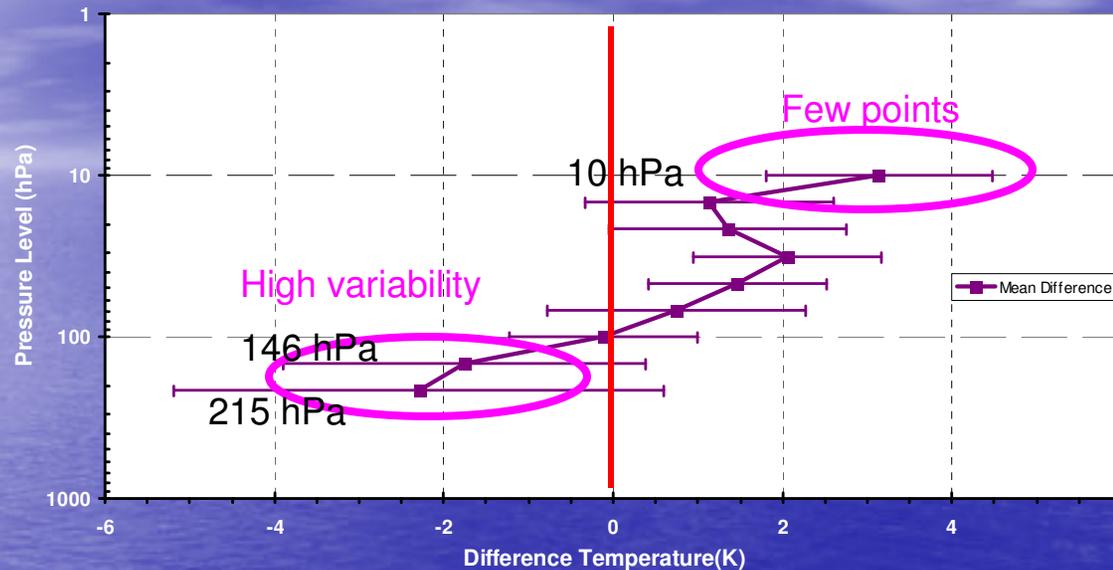


# Multiple Lidar-Sonde Comparisons – Comer, SSAI

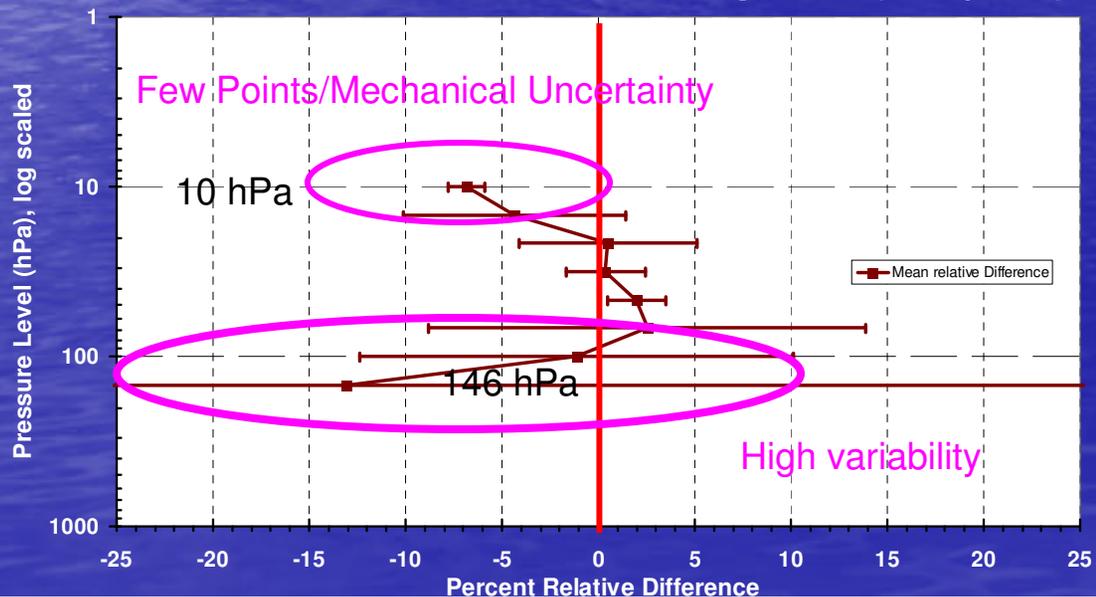


# MLS-sonde T, O<sub>3</sub> differences (v1.5, box averages) (C. Stearns, B. Bojkov)

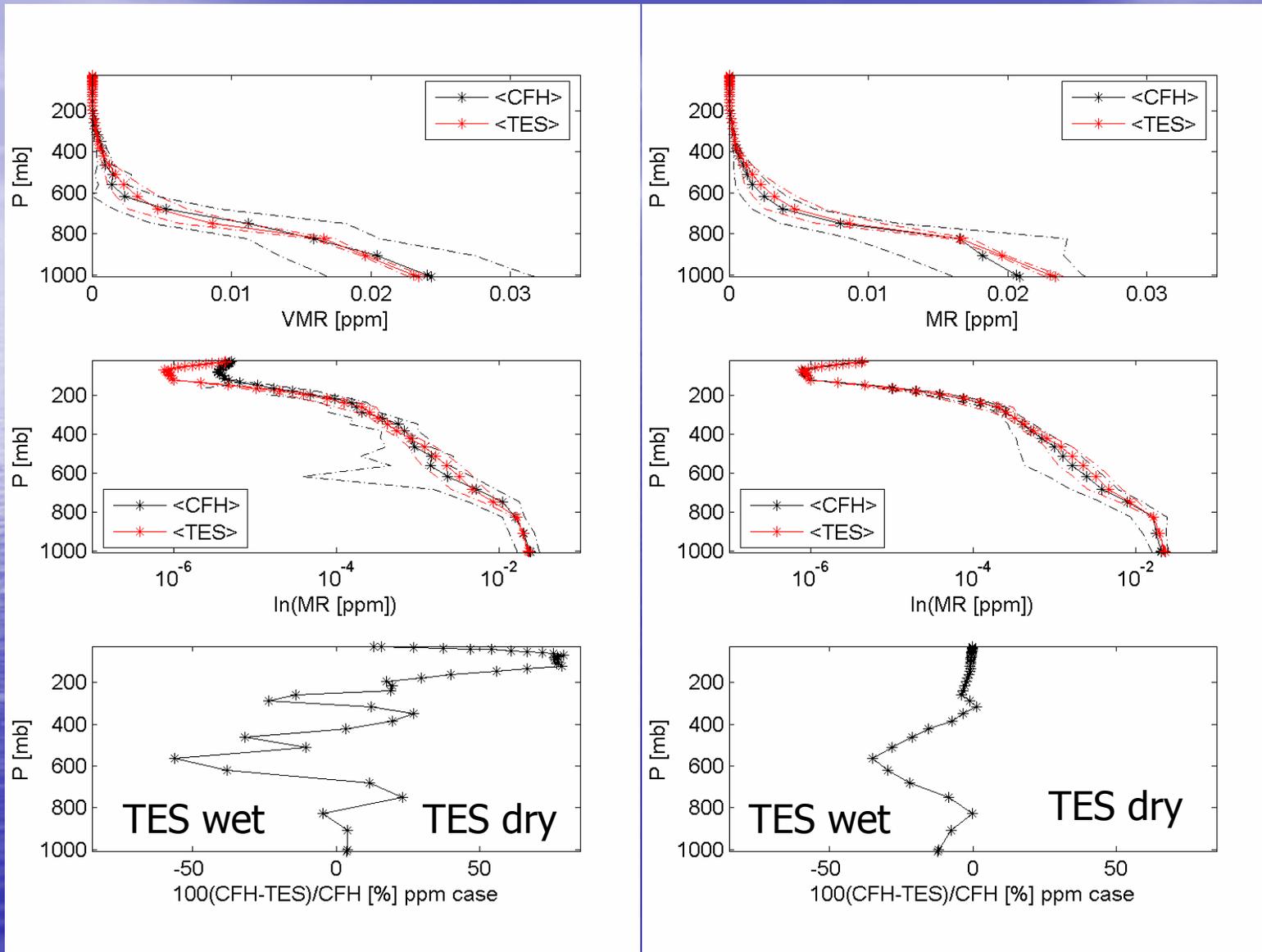
Mean Difference MLS-RS92 Box Average, Temperature (14 overpasses)



Mean Relative Difference MLS-RS92 Box Average, Ozone (6 overpasses)



# TES – CFH Water Vapor Comparisons – Adam/HU



Layer averaging

w/ TES Averaging kernels

# Air Quality?

Rabenhorst, UMCP

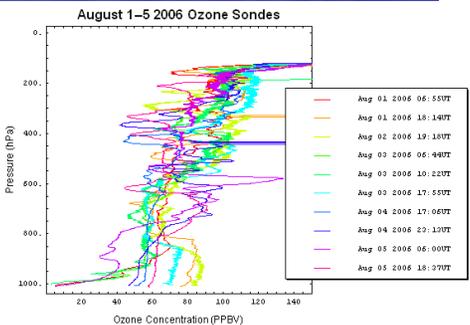
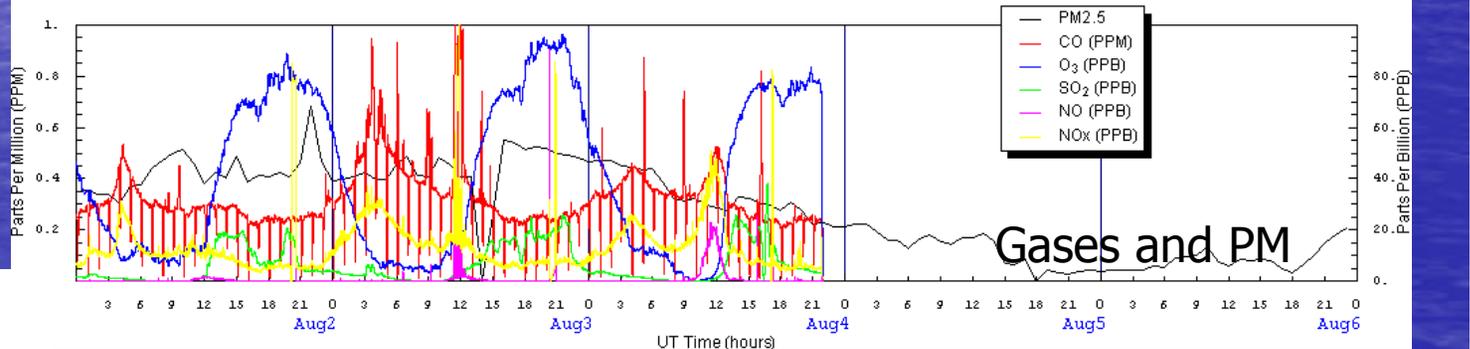
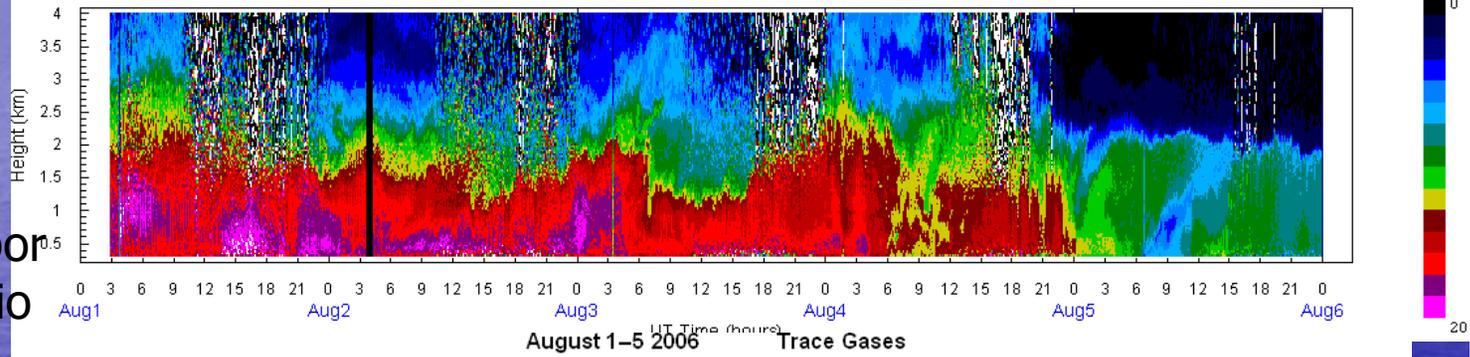
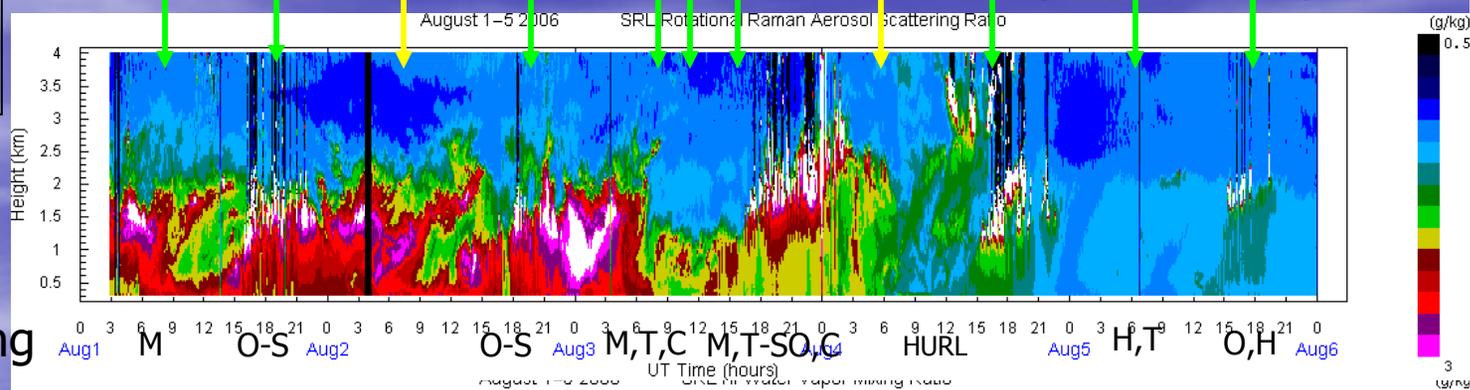


Aerosol scattering ratio

Water vapor Mixing ratio

Ozonesonde record

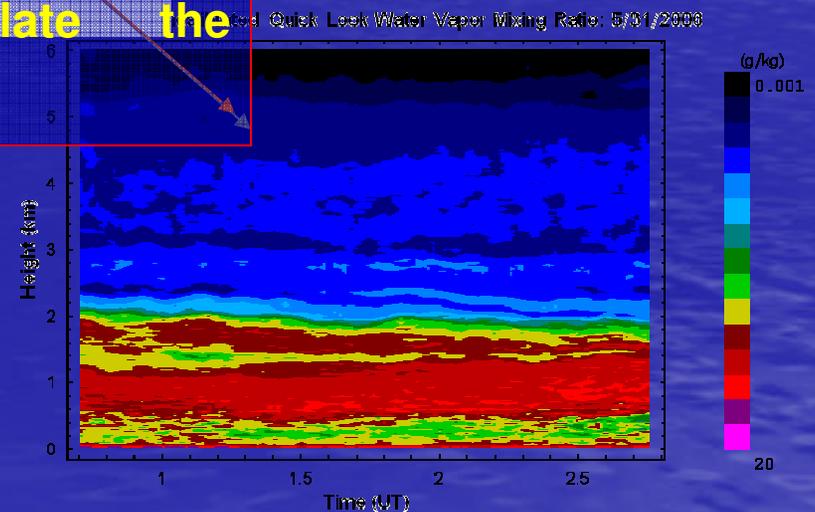
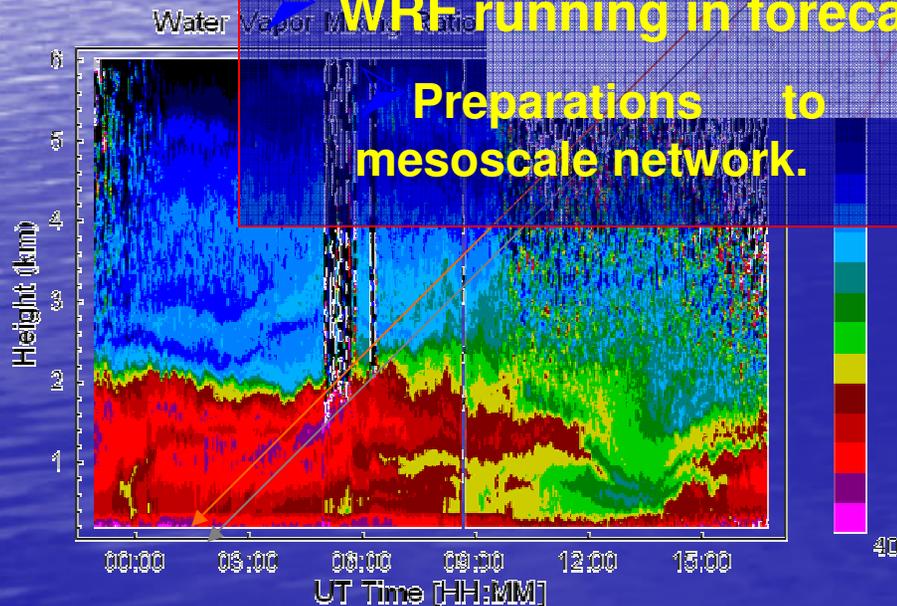
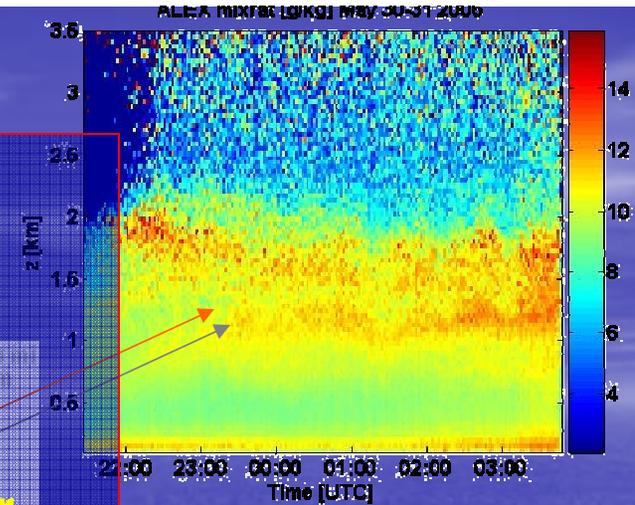
Arrows indicate times of sonde launches (O3 and PTU)



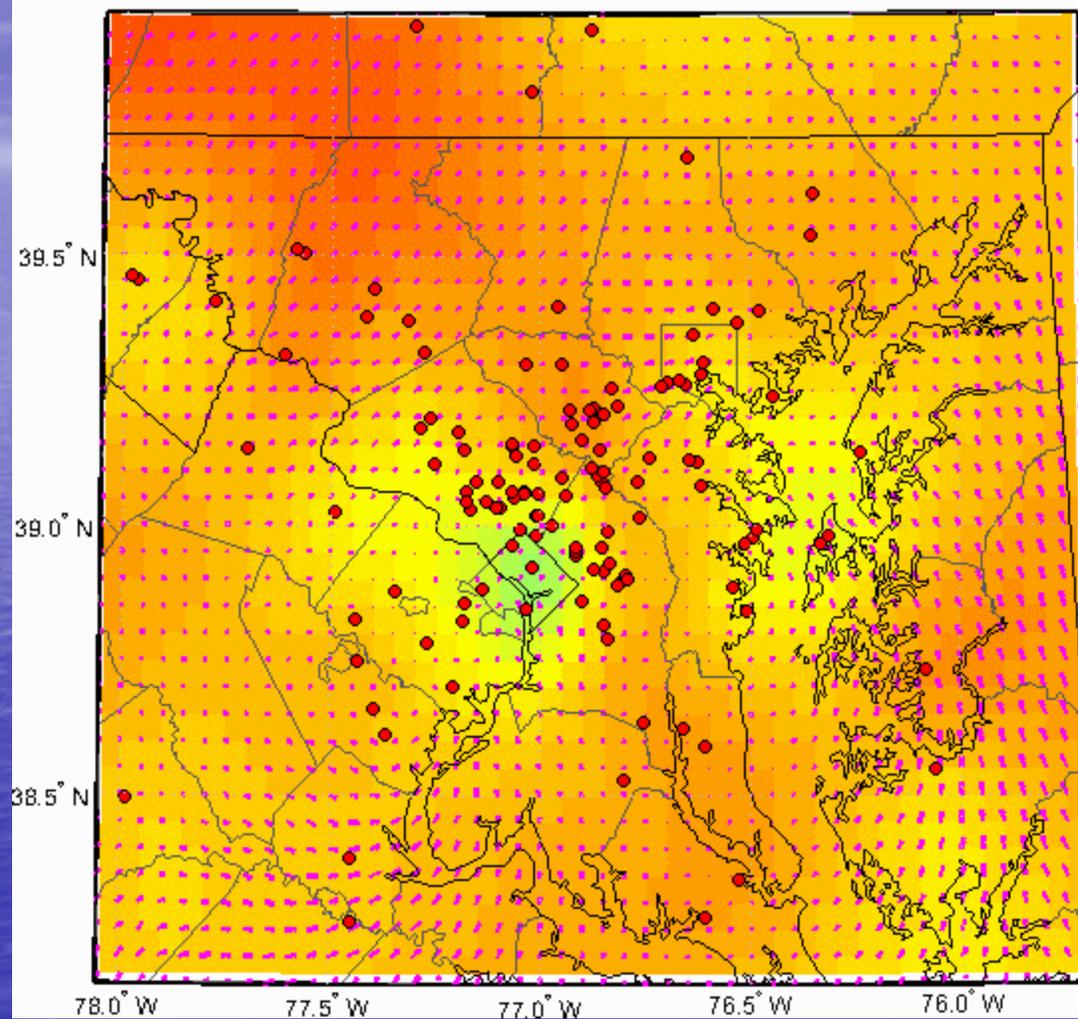
Five day sequence of lidar, ozonesonde, trace gas and PM measurements during a heat wave/pollution outbreak. PTU, PW and winds also available. Data such as these useful to couple ground and mid-troposphere.

## Tri-lidar (Raman) Network

- Howard University, UMBC, NASA/GSFC Raman lidars, GPS.
- Analysis of mesoscale water vapor and aerosol loading variability in various conditions.
- WRF running in forecast mode
- Preparations to assimilate the mesoscale network.



August 04 2006 00:00-01:00 EDT



# What's next

- Additional RS92/ozonesonde measurements this fall/winter
  - Beltsville and Table Mountain
  - Seasonal dependence
- Aura/AIRS comparisons using QC'd data
  - Ozone and water vapor comparisons with C. Barnet/NOAA
- WAVES 2007
  - Afternoon measurements for Aqua/AIRS
    - CFH, RS92, Lidar water vapor, aerosols
  - Proposed to augment
    - All overpasses to include O<sub>3</sub>
    - Morning measurements for METOP (IASI)

# Questions?

